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Linking Scientific Cognition and the Experience of Nature: On the Interferences of Religion and Science in the Writings and Life of Werner Heisenberg

ABSTRACT: Werner Heisenberg is one among several renowned modern physicists who engaged in discourses on the relationship between religion and science. While discursive and conceptual research on religion and science has largely focused on the boundary work between the social systems, cultural and aesthetical studies have shed light on their interferences. The focus on the interferences extends the research on religion in the life and writings of Heisenberg beyond his arguments and considers the aesthetic strategies of his writings along with his academic practices.

This article shows how through the model of “interferences” more than just Heisenberg’s interpretation of the world add to the relationships of modern religion and physics. Firstly, I offer an overview of Heisenberg’s biography to draw attention to the moments when he becomes a relevant figure in the modern history of religion and the historical sources accessible for textual analysis. Secondly, I introduce concepts developed in the framework of “European History of Religion” in order to demonstrate the religious tendencies and aesthetic ideologies in Heisenberg’s texts. Thirdly, I discuss narratology as a productive methodology to include the formal aspects of Heisenberg’s writing into the analysis. Ultimately, I will use two examples to show the different interferences in Heisenberg’s career and writings: the Romano Guardini prize speech and his romanticised narrative of the “founding moment” of quantum mechanics in 1925, published forty years later in his popular book Physics and Beyond (Der Teil und das Ganze).

KEYWORDS: Werner Heisenberg, religion and science, interference, history of religion, Modernity, Europe, quantum physics, aesthetics, narratology, Romanticism

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Introduction

In 1973, the Nobel Prize-winning quantum physicist Werner Heisenberg was awarded a prize by the Catholic Academy of Bavaria for his outstanding achievements in offering “interpretations of time and the world” in the spirit of the German theologian and priest Romano Guardini. With his acceptance speech, “Scientific and Religious Truth” (Naturwissenschaftliche und religiöse Wahrheit), Heisenberg not only engaged in the discourse on the relationship between religion and science but also linked the two social systems by accepting a prize from a Catholic institution. In his speech, he offers a “more general” definition of religion as the “spiritual Gestalt of a society” (Heisenberg 1985b, 428). He argued that religion should balance the material-oriented science of the “last Centuries” for an ethically sustainable future (Heisenberg 1985b, 438 f.). He based his argument on the changes in how the relationship between religion and science has been seen, and on the development of quantum mechanics and its consequences for our understanding of the world.

Heisenberg is just one of several physicists offering interpretations and meaning on the basis of their academic work. In his seminal work in 1986, the scholar of religion Burkhard Gladigow observed that modern physicists, like Albert Einstein and Max Planck, contribute to the wider history of religion in the 20th Century. They offer interpretations about the “religious implication” of their discoveries without any further education in religion. These “religious tendencies” within the natural sciences present a trend in the ways in which the functionally differentiated system of science becomes relevant for the modern history of religion (Gladigow 1986, 322).

The study of Heisenberg provides more than an interesting case study of this phenomenon. It also offers insight into a gap in Gladigow’s analysis, namely, the continuity between the religious tendencies in the writings of the modern physicists in early 20th Century Europe and those on the US-West Coast during the Cold War, such as the Fundamental Fysiks Group (Kaiser 2012).

Transfer processes between religion and science can take different forms, from the popularisation of theories to the production of new worldviews that are grounded in academic interpretations of reality. Together with his acceptance speech, Heisenberg’s popular memoir (1969) Der Teil und das Ganze. Gespräche im Umkreis der Atomphysik (Physics and Beyond. Encounters and Conversations (1971)) offers rich material to study the discursive interferences of social systems along with the transfers of epistemological objects and aesthetic forms. The bestseller highlights important moments of Heisenberg’s academic life, spanning the period from 1919 to 1965. He uses the form of conversations among friends and

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1 See for a short description of the Romano Guardini Prize and a list of past awardees the web page of the Catholic Academy in Bavaria: https://www.kath-akademie-bayern.de/ueber-uns/preistraeger.html
colleagues to narrate a wide range of topics, starting from his first encounters with particle physics, to a discussion about the consequences of quantum physics for religion in the evening of an academic conference and the relocation of the Max Planck Institute for Physics and Astrophysics to Munich in 1958.

Set in different environments from hikes in the Bavarian Alps to informal conversations at conferences, the discussions maintain a collegial tone, even when touching on the importance of scientific responsibility and the epistemological consequences of quantum mechanics. Apart from explicit conversations on the implication of modern physics for “religion,” the aesthetics of the text offer further insight into the modern history of religion and science. Heisenberg’s narration of his breakthrough in formulating quantum mechanics during a trip to the German island of Helgoland in 1925 is a famous example of how sensory elements and aesthetic modes play a formative role for the production and communication of academic knowledge.

At the end of May 1925, I fell so ill with hay fever that I had to ask Born to release me from my duties for 14 days. I wanted to travel to Helgoland, to cure my hay fever with sea air, far away from blooming bushes and meadows. […] Apart from daily walks and long swims, there was nothing in Helgoland to distract me from my problem, and so I made much swifter progress than I would have done in Göttingen. A few days were enough to jettison all the mathematical ballast […] and to arrive at a simple formulation of my problem. When the first term confirmed the energy principle, I was agitated […]. Since the results presented themselves without any effort, I could no longer doubt the mathematical consistency and coherence of the indicated quantum mechanics. At first, I was deeply startled [zutiefst erschrocken]. I had the feeling that through the surface of atomic phenomena, I was looking at an underlying ground [Grund] of strange inner beauty. I felt almost giddy at the thought of the wealth of mathematical structures, I now had to pursue. I was far too excited to sleep. So I left the house at dawn and headed to the southern tip of the Oberland, where a lone rock jutting out into the sea had always whetted my desire for climbing. I managed to climb the tower without too much trouble and awaited the sunrise on its top (Heisenberg 1985a, 89, emphasis and translation Schaa2).

The aesthetic exaltation of his academic breakthrough not only makes Heisenberg’s writings an interesting case for the study of cultural interference between social systems, but also shows how physicists

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2 Even though an English translation by Arnold Pomerans 1957 is available, I used the German text in agreement with Carson’s assessment that “Heisenberg’s German is more effective” than the more associative translation. I only build upon Pomerans version (Carson 2010, 150).
contribute to the new worldviews that emerge in the twentieth century. This article starts with an introduction to the historical persona and the material documenting Heisenberg’s life. The biographical overview is not extensive, but rather provides an idea of the diverse aspects of his life and outlines the material and epistemological limitation of the study. Second, inspired by Gladigow’s program of a European History of Religion, I present the communicative and cultural framework of the study, along with the relevant analytical categories from the history of science and the academic study of religion. Following from the conceptual framework, narratology presents a fruitful methodology to analyse the two examples.

A “brilliant physicist” and “average” citizen

Werner Karl Heisenberg was born on December 5th, 1901 in Würzburg. When his father, August, was appointed in 1910 as a professor of medieval and modern Greek philology at the University of Munich, the family moved south. Growing up in a bildungsbürgerliche (educated bourgeois) academic milieu, Heisenberg and his brother Erwin attended the Maximilian Gymnasium in Munich, an all-male institution of which their maternal grandfather, Niklaus Wecklein, had been the rector until 1913 (Cassidy 2009, 11–21). The neo-humanistic education there focused on Latin and Greek, teaching only the basics of mathematic and hardly any natural sciences (Heisenberg 1962). The bourgeois ideal of Bildung involved lifelong formation to become a complete man. The “liberal masculinity” and correct bürgerliche life were mediated by Bildungsroman (coming of age novel), requiring men to engage in high culture, physical activities, and political reflections (Davis 2008, 14).

Heisenberg was not drafted during the First World War, instead he stayed in Munich, helping at a farm in the summer of 1918 as part of the auxiliary service. When he returned to school in 1919, he became the leader of the “Heisenberg group,” a section of the Bavarian youth association. The members (‘scouts’) knew one another mostly from school and remained friends beyond the group’s formal dissolution around 1925. Notably, five of the twelve core members went on to study theology or become priests or religion teachers, with this being reflected in the topics of letters and the relationships among members. In preparation for Heisenberg’s wedding to Elisabeth Schumacher in Berlin-Dahlem on April 4th, 1937, Heisenberg shares “his position in regard to Christianity” with Wolfgang Rüdel, at the time a priest in Augsburg. While Heisenberg had distanced himself from Christianity when he first started thinking about the sciences, he now

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3 In the mid-1920s the first female teachers were employed and girls were subsequently admitted to the school (Bednar 2020).

4 I use the translation of “complete man” for the bürgerliche concept of the ganze Mann, to avoid any confusion with contemporary discourses about the “real man” standing up against the “crisis of masculinity” in a “post-industrial world.”
appreciated the ethical guidance of Christianity and recognised that the New Testament referred to the same reality as his own. Nevertheless, he says he does not understand the language of “the church,” a language just as much unsuited to speak of “the essence” as is the language of science. On the whole, his “position towards” life was mainly influenced by the scouts and the insight “that the world opens itself up” only to “the pure-hearted,” those who are “completely honest to themselves” (Heisenberg 6.4.1937 in Becker 2019, 449 ff.)

Figure 1: Heisenberg (left) with his parents and brother circa May 1919.

After his final exam in 1920, Heisenberg studied Physics with Arnold Sommerfeld, a pioneer of theoretical physics. Following his doctorate, awarded in 1923, Heisenberg secured a stipend from the Rockefeller Foundation to work with Niels Bohr in Copenhagen (1924–25). Reflecting on his education in series of interviews with Thomas Kuhn and John Heilbronn during 1962–3, he suggests that his limited training in classical (Newtonian) physics might have benefited his work on quantum physics. By applying Sommerfeld’s way of doing physics to figure out “how things are” and “to describe nature in mathematical terms,” Heisenberg cultivated a “feeling [sic]” to use the right “trick” to formulate the “mathematical scheme” for a “physical content,” rather than insisting on “mathematical foundations and proofs”(Heisenberg 1963). Complementing Heisenberg’s mathematical focus on physics, Niels Bohr fostered an interest for epistemological questions and the wider consequences his research had for the interpretation of reality (Heisenberg 1963). The dynamic environment of young and talented physicists from around the world working at Bohr’s institute in Copenhagen set the tone for Heisenberg’s ideal of the international family of physics (Heisenberg 1963, 1983, 183).

Before becoming a full professor of theoretical physics in Leipzig at only 26, Heisenberg worked as an assistant for Max Born in Göttingen and once again for Bohr. During this time, he published the seminal matrix formulation of quantum mechanics (1925) “Über quantentheoretische
Umdeutung kinematischer und mechanischer Beziehungen” (Quantum-Theoretical Re-interpretation of Kinematic and Mechanical Relations), and followed this with two more detailed papers on quantum mechanics that he, Born, and Pascual Jordan published in 1925 and 1926. Although the ‘three-man works’ (Dreimännerarbeit) as they were colloquial known became the point of reference, Heisenberg alone won the 1932 Nobel Prize in Physics “for the creation of quantum mechanics.”5 He further published an important paper in 1927 demonstrating the limits of knowing the exact position and momentum of a particle (the uncertainty is never smaller than the Plank constant), now widely known as the “Heisenberg uncertainty principle.”

Figure 2: Commemorative stamp of 2001 showing Heisenberg next to a formulation of the uncertainty principle.

Heisenberg's academic success and the rapid progress of quantum mechanics in the 1920s and early 1930s took place within the context of the political and cultural turmoil of the Weimar republic as well as his own personal unrest. Paul Forman argued (Forman 1971, 113) that modern physics’ dismissal of causality sacrificed “the scientific enterprise to the Zeitgeist” of the Weimar republic. The controversial thesis reframed historical studies of academic research, especially our understanding of the social, political, and cultural entanglements of science. Between Heisenberg’s academic ambitions, familial pressure, and a desire to spend every free minute in nature, he rarely reflected on the politics and culture of the Weimar Republic in letters to his parents or friends. Nevertheless, the

5 For the prize motivation and the details for the Nobel Prize award of the year 1933, see https://www.nobelprize.org/prizes/physics/1932/heisenberg/facts/.
letters bear witness of his economic situation and the political reasoning, along with his mental wellbeing. He reassures his father in 1926 that he will secure a decent position but prefers to stay in Copenhagen for now to invest in his promising research, instead of “ending his career” by settling for the “material” security of a professorship, like a “common bourgeoise” (Heisenberg 29.4.1926 in Hirsch-Heisenberg 2003, 101 f.).

Apart from the justification of his career, the letters indicate his economic dependence, from detailed expenses to thanks for food stamps. However, the tone shifts with his father’s death in 1930. He starts to offer his mother financial support, “by far the best use of my money” (Heisenberg 12.1930 in Hirsch-Heisenberg 2003, 180), reminisces on his father’s spirit, or complains about the “proletarisation of science” (Heisenberg 4.5.1934 in Hirsch-Heisenberg 2003, 226). Furthermore, it is apparent that physics, coming last after his parents, the mountains, his friends, and music, (Heisenberg 15.11.1926 in Hirsch-Heisenberg 2003, 113) is unable to “lighten” the “grey world” of “bodies” and “achievement” surrounding him (Heisenberg 27.10.1932 in Hirsch-Heisenberg 2003, 207). He committed to his marriage with the hope of leading a fulfilling family life and thereby enduring the “agonizing” and “political fights” and ugliness of what became in 1933 ‘the Third Reich’ (Heisenberg 14. and 21.11.1937 in Hirsch-Heisenberg 2003, 267f.).

Elisabeth Heisenberg illuminated the political side of Heisenberg in her 1983 memoire portraying her husband as an “unpolitical man.” Although she argued that her husband’s “scientific creativity” and the “dramatic changes of physics” left no room for political engagements prior to the Second World War (Heisenberg 1983, 40, 47), his letters to his parents indicate that he followed German and especially Bavarian politics. He expressed his delight about Hitler’s trial in 1924 and his disappointment that he won’t be able to cast a vote for the “Sozis”6 (Heisenberg 1.12.1924 in Hirsch-Heisenberg 2003, 67 f., 84). His love for his homeland and longing for harmony factored into his decision to endure the “catastrophe” in Germany, to ultimately rebuild the country he felt a sense of belonging and obligation towards (Heisenberg 1983, 77).

Heisenberg’s loyalty towards the country of his childhood coexisted with a sense of being European and part of the international family of physicists (Heisenberg 1983, 183). His international friends met his decision with reservations; his participation in the Uranprojekt (German nuclear weapons program) and his securing of prestigious positions from migrated academics caused tension. The close friendship with his former teacher, Niels Bohr, was especially tested. Heisenberg visited Bohr in Copenhagen during the Fall of 1941 where they discussed the development of nuclear weapons. The details of that conversation are not transmitted. However, recollections of it in notes and letters, from more than ten years after the

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6 *Sozi* is a colloquial expression for supporters of social democracy or socialism and members of corresponding parties.
war have shaped popular narratives in plays (Frayn 2002) and books (Junke 1958), as well as the course of the friendship.

After the war, Heisenberg engaged in various projects advocating nuclear disarmament, such as the 1957 Göttinger Manifesto opposing the plans of the German government to develop nuclear weapons but supporting the use of nuclear energy. In his research, he focused on a unifying field theory, which involved a break with his lifelong colleague, Pauli. Pauli felt rushed by Heisenberg, who used the 1958 commemorations of Max Planck to promote his research of a Weltformel (World Formula) (e.g. Pauli to Rosbaud 5.3.1958 in Pauli 2005, 1008 f.). Heisenberg held various national and international roles and promoted academic research, in particular particle physics in West Germany. Among other positions, he was President of the Alexander von Humboldt-Stiftung (1953–75), West German Representative at CERN and Vice-President of its Council (1958–60), as well as Director of the Max Plank Institute of Theoretical Physics in Munich (1958–70). This last position was especially joyful for him as it enabled him finally to move back to the city he called home, Munich. Heisenberg engaged in wider academic and cultural activities, such as holding the Gifford Lectures at St Andrew’s in 1955–6 (published in 1958 under the title Physics and Philosophy: The Revolution in Modern Science) or signing once again in 1961 the Tübinger Memorandum against nuclear armament, this time with fellow Protestant scientists.

In the late 1960s, the “brilliant physicist” published a humble memoir of his academic career, presenting “a rather average representative” of the educated academic upper class of Germany (Cassidy 2009, 409). The historian of science Cathryn Carson reads Heisenberg’s memoir and public speeches against the bildungsbürgerliche ideal of scientists. She concludes that they conformed with the ideal of a trained scientist as one who can embed the (new) knowledge within a “unified world picture,” offering guidance for the individual’s “action in the world” (Carson 2010, 33). Academic analysis, in other words, presented more than just specialised knowledge; it promised the revelation of truth, beauty, or even God, frequently leading to holistic approaches and even offers of meaning (Carson 2010, 459). Heisenberg, a complex and widely beloved person, died in Munich on February 1st, 1976 of cancer (Heisenberg 1983, 13 f.).

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7 For a detailed reconstruction of the historical documentation of Heisenberg’s visit, see Aaserud (2002) and for a discussion of the biographical significance, see (Cassidy 2009, 312–323).
8 For a reconstruction of how Heisenberg got the physics wrong, see Blum (2020).
9 The Gifford lectures, established in 1888, offered a place for philosophers to lecture on “Natural Theology,” in relation to science in the widest sense, in the absence of “any supposed special exceptional or so-called miraculous revelation” (giffordlectures.org).
Documentary sources

The extensive materials documenting Heisenberg’s life, his academic achievements, and his research network, along with his philosophical interests and family life, grant an insight into the history of modern physics and the modern history of religion. Due to the Second World War and Heisenberg’s arrest and subsequent internment in 1945 in Farm Hall (England) by the Allies, some notes and letters have been lost. The Max Plank Society holds the largest number of documents, now mostly digitalized and currently being indexed by a DFG-project located at the library of the University of Leipzig (expected completion March 2022). Further material is preserved by other archives as well as by individuals (family members or recipients of letters) around the world and are harder to research because of missing indexes or restricted access.

Additionally, a range of letters, works, and writings have been edited. One set of editions is a collection of primary documents, while another set has more the form of recollections. Most of the published works, talks, or essays were edited as collected works in the 1980s by three former students and colleagues of Heisenberg: Walter Blum, Hans-Peter Dürr, and Helmut Rechenberg. The collected works include the two books of Series A: Original Scientific Papers and Series B: Scientific Review Papers, Talks, and Books published by Springer and five books of Series C: Philosophical and Popular Writings published by Piper. Further, letters from Heisenberg are included in editions by his peers, such as Wolfgang Pauli Scientific Correspondence with Bohr, Einstein, Heisenberg, et al., published between 1979 and 2005. The other set, of a more recollective form, includes letters and notes edited by Heisenberg’s daughters who share the personal side of their father with a wider public and as well as explorations of the dynamics of his scout group. These books include an annotated edition of the letters exchanged with his parents (Hirsch-Heisenberg 2003), letters from the early years of his marriage with Elisabeth (Hirsch-Heisenberg 2016), and a
contribution to Heisenberg’s biography and the history of the youth
movement by Becker (2019). These books integrate the historical material
into the narrative and interpretation of Heisenberg’s biography, omitting
parts of letters and complementing them with personal anecdotes or
pictures.

Falling somewhere between these two approaches, Heisenberg
published his own recollection of his life “through his thoughts about
science, politics, philosophy, and religion” (Heisenberg 1983, 13). The
recollected moments span from 1919, just before he enrolled in physics, to
1965, when he was at last living back in Munich and working on a quantum
field theory as head of the Department of Theoretical Physics. Although the
book shows no “conspicuous misrepresentations” of the past (Carson 2010,
146) it has structured the narratives of some biographies (Fischer 2015). It
puzzles historians, who interpret it as a historical document from 1969,
rather than a sound autobiography. Heisenberg takes on the double role of
being a “spectator and actor” in the great drama of his own life (Heisenberg
1985a, 334). The book is entangled in economic considerations typical of the
time of publication (Carson 2010, 149), and had the political aim of shaping
public discourse about his role during the Third Reich. Elisabeth
Heisenberg went on to complement her husband’s reflections with her own
perspective of a complex persona, who was too shy to speak “on his own
behalf” (Heisenberg 1983, 13).

Religion and Science. Social systems and epistemic cultures of modern
society

Researching religion in Heisenberg’s writings and life draws attention to
the long history of interferences between the social systems of religion and
science in modernity. Neither the biographical nor the philosophical and
historical studies on Heisenberg include any extensive analysis of the
religious tendencies in his work, from the creation of his worldview to
finding meaning in the upheavals of the twentieth century and making
sense of quantum physics. The study of religion and science has largely
focused on the historical “boundary work” (Brooke 2014, 438) of the
modern “intellectual territories” (Harrison 2015, 115). In the last three
hundred years, the concepts and social spheres of religion and science have
changed profoundly. Although historical studies highlight the historicity of
modern concepts to refute “[h]istorical amnesia” (Harrison 2015, 19), they
don’t reflect on their reduction of science to natural philosophy, and
religion to Christian theology. The focus on natural science in the history of
science has been challenged by cultural and intellectual studies calling for
a more general understanding of science, closer to the German Wissenschaft,
following in the tradition of the Latin *scienta*, to include systematic research beyond physics, chemistry, or biology.\(^\text{10}\)

The mostly Whiggish history of ‘religion and science’ neglects the sociohistorical context within which embodied philosophers, theologians or academics proposed their scholarly arguments (Harrison 2015, 84). It is an intellectual tradition closely linked to analytical studies of the nature of the relationships between the two concepts, social systems, or practices. Ian Barbour in 1983 proposed what is the most prominent model for possible relationships. He promotes a “dialogical view” to “overcome the conflicts of the past,” that exist alongside the perspective of interdependence and integration (Barbour 1966, 359). His highly selective research serves the “pedagogic function” of fostering a “pluralistic dialogue” to find common ground (Barbour 2002, 345, 358f.). The androcentrism of the historical and philosophical studies is most apparent in the analytical extension of Barbour’s model by Mikel Stenmark. The philosopher of religion rejects any feminist theory or embodied epistemologies as “ideologically partisan” endangering “ideologically neutral science” (Stenmark 2004, 207) in a manner similar to “theistic science” and the privileging of the “religious practitioner,” arguing that scientific practices are “shaped by extra-scientific beliefs and values” (Stenmark 2004, 194). On the whole, scholars reproduce such binary distinctions as science/religion, cognitive/embodied, or rational/irrational.

More recent research has challenged these binary models and essentialist studies, also with regard to the wider discussions of secularisation theory and the concept of re-enchantment. Egil Asprem focuses on Max Weber’s concept of disenchantment and emphasises the “complex relations” between scientific naturalism and esoteric discourses in the early twentieth Century. Asprem shows that the relationships between what Weber called value spheres of “rational science and ‘genuine’ religious beliefs and practices” pose problems, which are not captured adequately by historical or philosophical work approaches (Asprem 2015, 306).

In a comparative way, Kocku von Stuckrad, applied a discursive approach and relates the dialectical history of religion and science to the wider understanding of the European history of religion. This approach assumes that, while Christianity has been a dominate force in European history, an inherent pluralism of religious traditions has shaped the development of other knowledge systems, including academic disciplines, such as astronomy (von Stuckrad 2010) or psychology (von Stuckrad 2019). Discursive studies show how crossovers between discursive fields have produced the contemporary configuration and materialisation of modern

\(^{10}\) For a more extensive discussion of the problem and the different solutions, see the Special Issue History of Science or History of Knowledge?, in: Berichte zur Wissenschaftsgeschichte 42(2–30), and Lorrain Daston’s presentation at the Dan David Prize (2018) “The Future of the History of Science: What isn’t the History of Knowledge.”
“religion and science” (von Stuckrad 2010, 15). While the discursive studies indicate the importance of power relations for the formation of discourses, along with material and sensory aspects of reality (von Stuckrad 2014, 181f.), they rarely shed light on the lived realities of the embodied beings contributing to the discourses with their practices and arguments. The case of Heisenberg indicates the wealth of material and data available to study the interference of religion and science, neglected by intellectual or discursive as well as analytical and historical research. Social networks, everyday practices within and beyond science, or the form of his writing are just some aspects that are neglected by studies focusing on arguments and concepts.

One of the most influential proposals to frame the relations between religion and science more conceptually has been developed by Gladigow when he introduced the programme of a “European History of Religion” in the early 1990s. Characteristic constellations and structures, rather than geographical boundaries demarcate Europe (Gladigow 2005, 289). One such constellation is the two-fold or multiple pluralism of religion. Multiple pluralism of religion describes the concurrent pluralism within religion and among the social systems of religion, science, or art. While the concept describes a structural phenomenon, it points to a critical moment. Turning the comparative lens towards Europe, it casts out the historical pluralism of competing worldviews, to question the singularity of a Christian Europe (Gladigow 2005; Kippenberg, Rüpke and von Stuckrad (Eds) 2009). The religious tendencies of physicists and newly developed interpretations of academic knowledge contribute to this pluralism of religion. Alongside the differentiation of science in modernity, religion lost its monopoly over the interpretation of natural phenomena, reducing religion to one social system among others. Furthermore, religion becomes an object of academic reflections and fascination (Grieser 2009). The “scientification of religion” (von Stuckrad 2014) fosters a wider move to contextualise religion, instead of affirming one’s interest, belief, or engagement in religion (Tenbruck 1993, 67). This academically endowed reflection about religion offers a mode to adjust to ever-present social changes by linking various discourses and embodied perception successfully to the growing number of worldviews and meaning-making practices (Gladigow 2005, 300 f.).

Drawing on Niklas Luhmann’s communication theory of a functionally differentiated modern society, the European History of Religion distinguishes religion and science by the characteristics of their communication and culture rather than by their essence. Religion is marked by the interpretation of reality and offers meaning, while science is distinguished by the communication of new and certified, true knowledge. Heuristic analysis highlights the diverse communicative and cultural interference of the social systems. Religious tendencies within the natural sciences, the transportation of aesthetics and worldviews by science (Borrelli 2017; Borrelli and Grieser 2017; Grieser 2013; Gladigow 2001), or the popularisation of academic knowledge of religion in the media (Grieser
2009, 2017) are some examples of how religion and science compete over the interpretation of the world and stimulate new offers of meaning. The transportation of religion by scholarly work has an especially long history and is closely linked to the colonial history of Europe. Missionary work and the appropriation of worldviews and cultures in comparative and linguistic studies added to the characteristic constellations, such as multiple pluralism (Gladigow 2003, 458–463), which also exceeds the geographical area of Europe in a connected world (Hermann 2015).

European History of Religion thus offers not only a framework to study the communicative production of science and the structural changes facing modern religion, but also analytical concepts to study the cultural roots of worldviews. Supporting the contextualisation of modern practices, topoi, or symbolic orders, cultural studies situate the research material in a longue durée. A central mechanism for securing the continuation of knowledge, behavioural patterns, or symbolic systems is professionalisation. Structural professionalisation of institutions and communication systems is intertwined with the professionalisation of individuals through training of skills, cultivation of behavioural patterns, or acquisition of knowledge. Professionalisation structure the ways in which practitioners of religion and science perceive and imagine the world (Koch 2017, 389).

Feminist critique of science and masculinity studies have shed light on the ways sex/gender have shaped the embodiment and symbolic structures of systematic knowledge production (Scott 1986; Haraway 1988; Harding 1991). Falko Schnicke highlighted, for example, how history became a masculine discipline within the German-speaking context of the nineteenth Century (Schnicke 2017a). Along with the research objects (the actions of great men), analytical categories, modes of perception, and habitus shaped not only the way historians presented their studies but also how they embodied their profession. Masculinity studies have offered a new perspective on the co-production of knowledge and the scholarly identities of men as the historically dominant sex within all-male spaces (Milam and Nye 2015, 14). They investigate how bodily disposition influences not only what is known but also how it is known and communicated, from self-sacrificial experiments in the name of scientific advancement (Golinski 1999) to sexualised metaphors (Schnicke 2017b). Studies of German scholarship and technology show how knowledge production and dissemination are entangled with bildungsbürgerliche values, including the distinction between private self-cultivation and public research Heisenberg promoted (Schnicke 2015; Paulitz 2012; Daum 2002).

While individuals train cultural semantics to make perceptions intelligible, sensory capabilities and the material environment regulate their perception (Grieser 2017, 244). A cultural and cognitive study of religion stresses the interaction of cultivation, perception, and communication recognised by embodied epistemologies, and challenges logocentric research traditions (Koch 2019, 26). To become effective cognition,
perception has to extend beyond the individual linking to ongoing discourses within social settings and in interaction with cultural objects (Koch 2019, 30). In the history of science, cultural approaches have drawn attention to epistemological objects (Rheinberger 1997), the embodied practices (Golinski 1990) within designated settings (Knorr-Cetina 1999) and the aesthetic modes of theoretical models (Borrelli 2015) involved in the production of knowledge and academic interpretations of the world.

Drawing on the concept of embodied epistemologies, cultural approaches draw attention to the aesthetic strategies of imagining non-knowledge and communicating overwhelming sensory perceptions (Grieser 2017, 451). Aesthetic ideologies (Grieser 2013) shape the way physicists perceive the world and communicate their knowledge beyond historical epochs. Romanticism, transported largely in bildungsbürgerliche novels, is such an effective ideology which regulated Heisenberg’s perception and semantics. The chosen epistemological and conceptual framework thus has methodological consequences for the study of Heisenberg’s material. On the one hand, the interference of religion and science is always a product of continuous communication acts. On the other hand, cultural and aesthetic research stress the bodily and material aspects stimulating and limiting knowledge and imagination. Therefore, I suggest that studying Heisenberg’s work benefits from rethinking the relationship between form and content and allows one to explore the various ways in which religion and science interfere in a wider perspective.

**Narrating the act of cognition**

Narratology offers a methodology for studying the content of Heisenberg’s work in interdependence with its form. While pure content analysis focuses on the logical validity of the ontological claims, narrative studies scrutinize the rhetorical strategies (White 1973), the invoked images (Borrelli 2020), or the sensory effects of a text (Feldt 2017). Narrative analysis recognises that the perceived and imagined world shared in texts becomes effective in the social field and cultural domains of shared sensory and mediated practices (Johannsen and Kirsch 2020, 3f.). Imagining something “as something else” is central to the interpretation of reality and presents multiple options for interferences between religion and science. In science, narratives are central strategies for imagining future knowledge, like mathematical formulae or particles that will confirm one’s theory (Borrelli 2015, 2017; Grieser 2013). Such epistemic ideals and research activities are shared in narrative cultures fostering the social inclusion of a scientific community and the formation of disciplinary identities (Borrelli 2020, 339 f.). Storytelling is not only an integral part of academic life and research but is also an essential mechanism for the popularisation of academic knowledge. Great narratives of scientific transformation and discoveries, such as the quantum
revolution, become effective in the public discourse of scientific progress or views of scholarly genius (Borrelli 2020).

Narrative analysis, like the rhetoric of religion, focuses on the ways in which the content and the form of a textual material are intertwined, such as the evocation of fascination (Grieser 2009) or the construction of the fantastic (Feldt 2012). The efficacy of the interaction between the content, its form, and the audience lies at the core of the analysis. If we apply an aesthetical view, academic and popular writings include not only cognitive arguments and storylines, but also sensory perceptions of beauty or a hierarchical order of reality. Furthermore, their content draws on formal strategies to stimulate responses and persuade the audience. Heisenberg, for example, presents modern physics as an inevitable succession of a linear history of scientific progress, dating back to Antique philosophy.

His narration of knowledge production draws on aesthetic strategies, such as the transformation of bodily agony dissolved in pleasurable beauty producing bio-somatic effects, from sensual arousal to emotions and imagination. The aesthetic form of a text can legitimise the argument and construct the speaker’s (and the reader’s) identity; it can also give form to the absent and to sensory perceptions. Embedded in culture, aesthetic ideologies manage the sensory perceptions of the writer as well as those of the reader. Carson suggests that Heisenberg’s public success stemmed from the bürgerliche values and knowledge he shared with his audience and the way he stimulated their imagination (Carson 2010, 143). Narrative analysis thus shows how aesthetic strategies relate modern religion and science in Heisenberg’s writings.

**Linking Cognition to the Experience of Nature**

Two examples will highlight the different aspects of the interferences between religion and science in Heisenberg’s work, from religious tendencies to the aesthetics of cognition. Both texts, a price speech from 1974 and his memoir from 1969, were intended for a wider audience, being disseminated through recordings and publications, including translation into English.

Heisenberg held his speech on “Religious and Scientific Truth” in front of a largely Roman-Catholic audience of the Romano Guardini Prize ceremony in 1973. However, it also reached people sitting in front of their television and radio, along with the readers of German newspapers from the progressive-liberal Süddeutsche Zeitung or the liberal-conservative Frankfurter Allgemeine (Carson 2010, 129). In his speech, Heisenberg proposed an inclusive definition of religion as the “spiritual form” of a society, the foundation of ethics and the meaning of human life (Heisenberg 1985b, 428). He acknowledged that while his audience was familiar with the points made about religion, he wanted rather to show that “scientists have...
to recognise the importance of religion for societies” if they were going to think about religion and scientific truth (Heisenberg 1985b, 430).

Thus far I have not had the opportunity to review the reasons given by the prize committee for awarding the prize to Heisenberg, or what made him accept it. Carson suggests that he was considered to be a good fit to offer a “conciliatory address from the scientific side” after the Second Vatican Council from 1962-5, did not include a formal apology for the “Galileo affair” (Carson 2003, 131). Carson shows further that Heisenberg had been in contact with outspoken reformers of the German-speaking Catholic church, such as the Jesuit theologian Karl Rahner and the Archbishop of Vienna Cardinal Franz König (Carson 2010, 130–3). König thanked Heisenberg for his remarks “on Galileo,” concluding that religion has to balance out the material world of contemporary “natural science” to ensure a liveable future (Heisenberg 1985b, 349).

Heisenberg argues in his speech that the trials against Galileo mark the origin of the history of conflict between religion and science within the “intellectual history of Europe” (Heisenberg 1985b, 430 f.). The conflict he says is the result of fundamental dissent between worldviews and conceptions of truth. Furthermore, he argues that religion and science are distinct by their role in society and in language. Full of “images and parables,” the language of religion can provide “trust in the world” and offer “meaning for our existence” (Heisenberg 1985b, 430). Scientific language, on the other hand, is characterised by the mathematical idealisation of natural phenomena, preferably in controlled settings, to present the empirical principles of objective truth (Heisenberg 1985b, 426). This sharp distinction is challenged by the language required to communicate both the phenomena and the cognition of quantum physicists. Quantum physics does not only reframe the relationship between the phenomena and their observation but also refrains from precise language in order to capture the new level of “abstraction,” revealing the limits of modern science. Because of the high level of abstraction, the language of modern physics must draw heavily on “allegories and images,” bringing it closer to religion. Heisenberg concludes that a more “subtle thinking” has to be developed, in light of quantum mechanics to avoid any confusion with religion (Heisenberg 1985b, 436). The speech presents a welcome source for Christians seeking a renowned physicist confirming the importance of religion (Carson 2010, 128). Additionally, it offers a “religious interpretation” of a “paradigm shift” in physics, making academic knowledge attractive for the development of worldviews.

The second example is Heisenberg’s Der Teil und das Ganze, a heavily advertised book, published just in time for Christmas sales, became a bestseller that same year (Carson 2010, 144–50). In 1970 the book was awarded the Sigmund Freud Prize for Academic Prose. The jury of the Deutsche Akademie für Sprache und Dichtung were convinced by the “excellent language” Heisenberg produced to talk about “the difficult
subject of theoretical physics” proving “the utility of language as a tool of knowledge.”

The role of language in cognition is a central theme of the book and is reflected in its dialogical structure. Heisenberg settled on the form of conversation to highlight different moments of his life as a physicist. This form supported his argument that “science is produced in conversations” (Heisenberg 1986, 9) and that science is fiercely debated, as in the “Battle of Ascona” over the formulation of Quantum Field Theory with Wolfgang Pauli 1957 (Heisenberg 1986, 314). To amplify the collegial setting and “vivid atmosphere” he addresses renowned colleagues mainly by their first name and uses the collegial form of the German “you” (Heisenberg 1986, 10). Only two of the conversation partners are women, his wife and the mathematician Grete Hermann. Further, female figures do not engage in any debates, serving merely as statisticians, from caring family members (Heisenberg 1986, 109, 256, 305), to a plum-throwing girl (Heisenberg 1986, 66) and a concerned landlady in Helgoland (Heisenberg 1986, 88). This overall conveys science as an all-male space, without any equal female academics. Although Heisenberg grants the debate with Hermann an entire chapter about “Quantum Mechanics and Kantian Philosophy,” he characterises her as a “young philosopher,” willing to defend Kantian causality against two experienced quantum physicists, Heisenberg and von Weizsäcker. He neglects to mention that Hermann, who was still alive and nine months older than him, had earned a doctorate of mathematics under the supervision of Emmy Noether before she visited Heisenberg’s institute in Leipzig to work on the reconciliation of “a neo-Kantian conception of causality with the new quantum mechanics” (Bacciagaluppi and Crull 2009, 378).

One motivation of the book is to invite the wider public to engage in the debates around “fundamental philosophical, ethic, and political problems” reformulated by modern physics (Heisenberg 1969: 10). Intended as a philosophical game of chess with his close friend, former student, and philosopher Carl Friedrich Freiherr von Weizsäcker, Heisenberg settles on a “historical narrative” of his “philosophical expositions” as Platonic Dialogues (Carson 2003: 148, Liesenfeld 1992).

Ancient philosophy not only inspires the form of his book but also makes repeated appearances in his philosophical arguments. He begins the book with a quote from “Pericles's Funeral Oration” by the Athenian historian Thucydides, about the limits of remembering past conversations, while aiming at a close recollection of what was said (Thucydides after Heisenberg 1986, 9). Acknowledging Thucydides’ point, that recollected conversation are not literal, Heisenberg’s book does not include “actual


12 On Heisenberg’s dismissal of Herrmann’s academic and philosophical work, see (Bacciagaluppi and Crull 2009; Soler 2016).
memories” but rather the mediation of the “atmosphere” within which science is produced (Heisenberg 1986, 9 f.). In the first chapter, Heisenberg describes vividly the impression that Plato’s dialogue of Timaeus had on him and the way the philosophy of the “smallest objects” leads to the cognition of mathematical forms. The fascination evoked by Plato’s philosophy runs through the whole book, ending in a chapter about “Elementary Particles and Platonic Philosophy” (1961–1965), which raises the question of the compatibility of Platonic forms and the logic of quantum physics, especially the relationship between particles and their mathematical characteristics (Heisenberg 1986, 332). In both examples Heisenberg presents quantum physics as a linear successor to the antique philosophy of the material world, presenting solutions to centuries-old problems (Heisenberg 1985b, 424).

Heisenberg’s recollection of his cognition on Helgoland explains his contribution to solve a pressing problem in physics to further the mathematical description of nature. The relevant chapter entitled “Quantum Mechanics and a Talk with Einstein (1925–1926)” starts with a description of the state of quantum mechanics in the early 1920s and links it to a hike with his scout friends in the Austrian Alps 1924 (Heisenberg 1986, 86). Heisenberg offers a pictorial description of a misty climb to the Guffert with the sun breaking through the fog to lighten a rock, confirming the scouts’ whereabouts, and ultimately rewarding their persistence with a view of the Alps above a sea of fog. The notes of a fellow scout, Eberhard Rüdel, confirm the hike, including the rainy weather and the sunshine at the top (Becker 2019, 339f.). Heisenberg continues the chapter with his trip to Helgoland and the cognition that would lead to the foundational publication of quantum mechanics. He ends the chapter discussing with Einstein the epistemological consequences and empirical validity of the newly presented mechanics. The sections refer to one another, intensifying the aesthetics of parallel cognition and immediate experience of nature.

Heisenberg’s escape to Helgoland to recover from a hay fever attack in June of 1925 is documented and so are his severe hay fever attacks every year. His stay also offered a welcome break from his obligations at the University of Göttingen and an opportunity to focus on the mathematical problems on which he was working to advance modern physics. In the absence of external stimulations, “apart from daily walks and swims” and breathing “the sea air” while enjoying the endless view over the dunes, Heisenberg immersed himself in the scientific problems. Soon he had clarified the calculations from the “mathematical ballast,” to find “a simple mathematical formulation to his question” (Heisenberg 1986, 88). The results continuously validated the envisaged mathematical formula, cumulating in an evening of intense calculation at the end of which the solutions “present themselves.” Heisenberg’s proof of the mathematical consistency of quantum mechanics in Helgoland was followed by collaborative publications with Born and Jordan presenting the mathematical formulation of modern physics. To commemorate
Heisenberg’s “breakthrough” the German Physics Society and the Max Plank Institute for Theoretical Physics erected a stone on Helgoland in 2000. Heisenberg’s narration of his breakthrough includes bio-somatic modes of feeling “startled,” “dizzy,” or “too excited to sleep”, accompanied by aesthetic judgments of “beauty” and “simplicity” or the breakthrough of the surface of atomic phenomena. Furthermore, Heisenberg parallels cognition with the experience of nature. The “gaze of the strange inner beauty” of nature was “not more” than the sun-lighted rock he had seen at the Guffert. Through this narrative structure, Heisenberg embeds his perception and achievements in a Romantic aesthetic and the paradigmatic Caspar David Friedrich’s “Wanderer over the sea of fog” (c 1818). A sense leads the scouts and the young physicists through “an obscure tangle of rocks and slopes,” “the moving wafts of mist” and an “impenetrable thicket of complicated mathematical formulas” (Heisenberg 1986, 87). Their persistence is rewarded when reaching “the sunny saddle heights above the sea of fog” (Heisenberg 1986, 86) and the gaze of the wealth of nature’s beautiful mathematical structures (Heisenberg 1986, 90).

Ultimately, the Alps present themselves “in full clarity” to the hikers, leaving no doubts about the further ascent (Heisenberg 1986, 87). Similarly, the final result casts any doubts aside of the “construction of a closed and mathematically sound structure” of modern physics (Heisenberg 1986, 90). Furthermore, a rhetorical shift from bodily agony, stagnation, and high contemplation to the effortless calculation of results is reinforced by another anecdote. Too excited to sleep after his cognition at three in the morning, Heisenberg recounts how he painlessly climbs a lone rock jutting out into the sea, to await the sunrise. In his eyes, the effortless calculation and unveiled beauty of the “simple” formulation vouch for the accuracy of quantum mechanics, while conveying the immediacy of cognition (Heisenberg 1986, 89). Ultimately, he ties the hyper-subjective cognition back to the social certification of academic knowledge, when illustrating the intensive work back in Göttingen of editing his initial calculation for publication (Heisenberg 1986, 89).

The scientific transformation in the light of the developing quantum mechanics is reduced to the narrative of one cognition, the mathematical formulation describing the structure of particles, proposed by Heisenberg. Heisenberg narrates his scientific breakthrough interlinked with his immediate experience of nature in the Alps and on Helgoland. The aesthetic strategy portrays the cognition as a shift from agony and obscurity to effortlessness and clarity. Aesthetic judgments and images of nature amplify the novelty and singularity of the new mathematical formulation, which lets Heisenberg see behind the “veil” of material particles. The Romantic aesthetics of immediate experience and sensibility towards the natural world are heightened by a sacrificial commitment to the ideals of science (Golinski 1992, 19).

Heisenberg’s immediate cognition of the beauty and mathematical structures of nature collapses the subject-object difference (Johnston 2019,
upheld by classical mechanics (Daston and Galison 2007). Carson argues that the collapse between subjective and objective helped to popularise Heisenberg’s writings and persona. His “bourgeois sensibilities” and presentation of “private roots” appealed to a post-War audience, which was sceptical of both “inhuman scientists” (Carson 2010, 143) and “the aristocratic ideal of masculinity” (Mosse 1996, 7). He skilfully balanced the subjective angles with a self-restrained corporality and professorial voice vouching for the objectivity of science (Carson 2010, 143; Coen 2007, 352). Although it is hard to assess the effect of his writings, Carson suggests that the audience sharing his bürgerliche values and cultural knowledge was an important factor in the success of his books and the positive reaction to his cultural engagements, including speeches at an institution of the Catholic Church (Carson 2010, 251).

Heisenberg’s narrative of the foundational moments reproduces, what Borrelli (2020, 315) describes as a “shared conceptual and performative framework,” fostering belief in “central tenets.” These foundational moments are aspects of the religious tendencies in Heisenberg’s writings and popular topoi of brilliant scientists. In this way, analysing the aesthetic strategies Heisenberg applies in his writings gives access to how a scientist imagines – and establishes – an understanding of scientific knowledge formation that is linked to the religious imaginary of its time.

Conclusion

This article takes the religious tendencies in Werner Heisenberg’s writings and social engagement as a starting point for a revision of sources documenting the life of an eminent physicist. Heisenberg’s lifelong friendships with theologians, his interactions with Catholic institutions, and the aesthetic strategies of his popular writings call for a redirection of conceptual frameworks for the study of religion and science. The expansion of the European History of Religion with masculinity studies and aesthetic methodologies presents a communicative and cultural framework to determine and qualify the ways Heisenberg becomes relevant for the modern history of religion.

I have determined three ways in which modern religion and science interfere in Heisenberg’s biography and writings. First, the Nobel laureate of physics related to social systems through his actions, such as the acceptance of the Romano Guardini Prize, and through his social network, which included renowned physicists and priests alike. Secondly, he engaged in the communication systems of religion, such as the consequences of quantum physics for the interpretation of the world or the meaning of life and, in particular, the relationship between modern science and religion. Lastly, the form of Heisenberg’s writings and narrative
strategies brought aesthetic ideologies, such as the Romantic experience of nature into conversation with academic knowledge production.

This case study of Heisenberg adds to our understanding of the history of modern religion and helps to move the research on religion and science forward, as indicated by Gladigow (1986, 2005). Moreover, it presents a model for the study of new worldviews grounded in academic research and knowledge of quantum physics in particular. Heisenberg’s suggestion that modern physics provides a turning point for the relationship between religion and science becomes a popular narrative (e.g. Rovelli 2019, 2021), alongside providing momentum for the development of new worldviews by physicists in the 1970s (Capra 1979; Zukav 1979; Wheeler and Ford 1998).

This article makes two novel contributions. Firstly, the article focuses on the cultural, social, and aesthetic interferences of religion and science in Heisenberg’s writings and life, rather than the boundary work in his arguments. In doing so, it exposes the plurality of relationships among the social systems, from the aesthetic form of the texts to the networks and embodied practices of knowledge production, which have gone unnoticed by historical studies (Harrison 2015; Asprem 2018), by discursive analysis (von Stuckrad 2010; Vollmer and von Stuckrad 2016), and by proposed models (Barbour 1966; Stenmark 2004). Secondly, narratological analysis of the texts illustrates the communication of bodily disposition and overwhelming sensory perception alongside the aesthetic strategies of imagining. The aesthetic formalisation of Heisenberg’s academic breakthrough in Helgoland in correspondence with a romanticised experience of nature shows how academic advancement is presented as a singular moment accomplished by an extraordinary (male) scientist; specifically, an extraordinary scientist who has the necessary intuition towards nature and also the vision to reflect on the wider consequences of his new theory.13

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**Figures**

13 I hope to show in future research how Heisenberg contributed to the development of worldviews drawing on quantum physics, and to explore the intersection of religious tendencies and aesthetic context which made his writings so persuasive.
Figure 1. Heisenberg’s family ca. 1919 in Becker 2019, 31. Preproduction with permission of the author.


Figure 3. Heisenberg 1973 with his wife Elisabeth and Franz Heinrich accepting the Romano-Guardino-Preis. Istvan Bajzat Reproduction with the permission of dpa/picture alliance.

References


